

Part 1. Report Cover

Report Number: DLAD028

Report Date: 29 April 2002

Previous Report Number: 00AYP003

Previous Report Date: 4 Feb 00

Title: Performance Oriented Packaging Testing of a
55-Gallon, Forged Lug, Steel, Open Head Drum
(1.3 mm/1.1 mm/1.1 mm), with 1-Gallon, Round,
Plastic Bottles (Quantity of 8)

Responsible Individual: Francis S. Flynn

Performing Activity: LOGSA Packaging, Storage,
and Containerization Center
ATTN: AMXLS-AT
11 Hap Arnold Boulevard
Tobyhanna, PA 18466-5097

Performing Activity's Reference(s): TT 10-02; TE 35-97; TE 67-96
AMC 13-88

Requesting Organization(s):

Defense Logistics Agency
Defense Distribution Center
ATTN: DDC-J-3/J-4-0
2001 Mission Drive
New Cumberland, PA 17070-5000

Requesting Organization's Reference(s):

1. Memorandum from DLA, 12 Dec 01

Part 2. Test Results: ___ single X combination ___ composite

Section I. Pre-test Conditions

For initial testing, one drum was received in new condition.

The following identification schema designates the packaging specimen(s) used for the test(s) indicated.

<u>Specimen No.</u>	<u>Test</u>
A	stack test
A	repetitive-shock vibration test
A	flat onto top, drop test
	flat onto bottom, drop test
	diagonally onto top circumferential chime, drop test
	diagonally onto bottom circumferential chime, drop test
	flat onto seam, drop test

Prior to testing, each bottle was filled, unless otherwise noted, with propylene glycol. Substitution for the actual hazardous item (material) is permitted by 49 CFR §178.602(c).

Section II. Summary

A. Drop test	PASS
B. Stacking test	PASS
C. Vibration standard	PASS
D. Leakproofness test	N/A
E. Internal pressure/Hydrostatic pressure test	N/A
F. Water resistance test	N/A
G. Compatibility test	N/A

To be certifiable, the configuration must pass the applicable tests for the type packaging, intended lading, and mode(s) of shipment.

Part 2. Test Results (continued)**Section III. Discussion****A. Drop test:** 49 CFR §178.603**Test date(s):** 3/12/02

- ☒ cold conditioned (0° F, 72 hr)
☐ ambient conditions (72° F)
☐ standard conditions (50% RH & 23° C)

No.	Ht.	Orientation	Results
A	71"	Flat onto drum top	Pass. No leaks/rupture; entire contents retained
A	71"	Flat onto drum bottom	Pass. No leaks/rupture; entire contents retained
A	71"	Diagonally onto top circumferential chime	Pass. No leaks/rupture; entire contents retained
A	71"	Diagonally onto bottom circumferential chime	Pass. No leaks/rupture; entire contents retained
A	71"	Flat onto seam	Pass. No leaks/rupture; entire contents retained

For each orientation for the drop test, a quick release hook fixed to an overhead crane, was used to lift the drum 1.8 meters (71 in.). The impact surface was a steel plate.

The decision to use the same container (configuration) for all five drop orientations was based on the relatively minimal damage demonstrated during previous testing of UN1A2 drums with different inner containers or articles. Five drops per configuration exceeds 49 CFR §178.603 requirements, as well as both UN and ASTM recommendations (i.e., one drop on a side or circumferential chime per drum). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

B. Stacking test: See 49 CFR §178.606. **Test date(s):** 2/26/02

- ☐ standard conditions (23° C & 50% RH)
☒ ambient conditions (72° F)
☐ high temperature conditions (104° F)

No.	Length	Type	Force (Required)	Results	Stability Maintained?
A	24 hr.	Static	1032 lb	Pass. No leakage or rupture	Yes

A static top load (2,000 lbs) was used for the stack test, because it could hold the load constant for the required 24-hour timeframe. The total top load applied on the empty drum was greater than the minimum required for one drum based on the outside drum height and the gross packaged weight. The top load was to simulate a stack of identical packagings that might be stacked on the packaging during transport.

Part 2. Test Results: Section III (continued)**C. Vibration test:** 49 CFR §178.608**Test date(s):** 3/15/02

No.	Frequency	Duration	Results
A	3.97 Hz	1 hr	Pass. No leakage, rupture, or damage

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of packaging certification marking (49 CFR §173.24a(a)(5)), the vibration test was performed, as a means to determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the steel drum packaging. The packaging was tested using a 4,000-lb vibration table (rotary motion) that had a 1-inch vertical double amplitude (peak-to-peak displacement) such that the packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

D. Leakproofness test: Reference paragraph 49 CFR §178.604. Test not required.

E. Internal Pressure/Hydrostatic Pressure test: Reference paragraph 49 CFR §178.605. Test not required.

F. Water resistance (Cobb Method) test (fiberboard): Reference paragraph 49 CFR §178.516. Test not required.

G. Compatibility test (plastics packagings only): Reference paragraph 49 CFR §173.24(e)(3)(ii). Test not required.

Part 3. Test Personnel

A. Drop test (49 CFR §178.603)

B. Stacking test (49 CFR §178.606)

C. Vibration standard (49 CFR §178.608 and §173.24a(a)(5))

D. Leakproofness test (49 CFR §178.604) - N/A

E. Internal pressure/Hydrostatic pressure test
(49 CFR §173.27 and §178.605) - not performed (capability assessment)

F. Water resistance standard (49 CFR §178.516) - N/A

G. Procedure for Testing Compatibility and Rate of Permeation in Plastic Packaging and Receptacles
(49 CFR §173.24, app B to part 173) - N/A

Part 3. Test Results: Section III (continued)

The following personnel performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein-- Richard D. LaFave, Bruce W. Samson, Timothy L. Reimann, and Karen K. Kimsey

Part 4. References

A. Title 49 Code of Federal Regulations, Parts 106 and 180, Winter 2002, current as of October 15, 2002

B. International Air Transport Association Dangerous Goods Regulations, 39th edition, 1 January 1998

C. ASTM D 4919, Specification for Testing of Hazardous Materials Packagings

D. ASTM D 999, Standard Method for Vibration Testing of Shipping Containers

E. ASTM D 951, Standard Test Method Water Resistance of Shipping Containers by Spray Method

F. TAPPI Standard: T 441 Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test)

G. Recommendations on the Transport of Dangerous Goods, sixth revised edition, United Nations, New York, 1990

H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material, 23 Jul 96

Part 5. Equipment

Item	Manufacturer	Serial No.	Calibration Expiration Date
4,000-lb vibration table	Gaynes Engr. Co. Franklin Park, IL	G20765	see note
30,000-lb compression tester	Gaynes Engr. Co. Franklin Park, IL	G20950	4/03
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R
cold chamber	Tenney Williamsport, PA		

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.

Appendix A

Test Applicability

Pass/fail conclusions were based on the particular bottles and drum specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings. It was not possible to identify the exact composition of the drum construction materials.

Testing was performed per Title 49 Code of Federal Regulations, subpart M of part II.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous lading and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration that simply uses the performance tested drum. Packaging paragraphs apply.

Appendix B

Test Data Sheet

Section I. Test Product

Physical State: solid X liquid gas aerosol

Stacking Weight Formula, Liquids - DLA

Variables		Inputs	
h	height, drum/box	34.375	
n	# stacked containers	XXXXXXXXX	3.433
w1	weight, drum/box	47	
w2	weight, bottle or can	0.25	
w3	weight, ring/pad	0	
q1	# inner containers	8	
v1	max. volume, 1 inner container	1	
v	total volume	XXXXXXXXX	8
w4	net weight, item unpacked	8.3	
W5	weight, absorbent	133	
W	total weight	XXXXXXXXX	248.4
C	constant	1	
A1	Stacking weight-PG I	XXXXXXXXX	794.3
A2	Stacking weight-PG II	XXXXXXXXX	889.3
A3	Stacking weight-PG III	XXXXXXXXX	1031.8
A11	Stacking weight, rounded-PG I	XXXXXXXXX	795
A21	Stacking weight, rounded-PG II	XXXXXXXXX	890
A31	Stacking weight, rounded-PG III	XXXXXXXXX	1032

NOTE: A1 = (n-1) * [w+(1.2*v*8.3*0.98)*c, Packing Group I
A2 = (n-1) * (w+(1.8*v*8.3*0.98)*c, Packing Group II
A3 = (n-1) * (w+(2.7*v*8.3*0.98)*c, Packing Group III

A1 = stacking weight in pounds, PG I

A2 = stacking weight in pounds, PG II

A3 = stacking weight in pounds, PG III

$n = (118/h)$, minimum number of containers that when stacked, reach a height of 3 m

$$w = w_1 + (w_2 * q_1) * (w_3 * q_1) w_5, \text{ total weight in pounds}$$
$$v = v_1 \cdot q_1, \text{ total volume}$$

C = either 1.5 (the compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing), or 1.0 (static top load)

Drop Height: Ref: 49 CFR §178.603

1.8 m; 71 in. (PG I, II, & III, SG 1.2 or solids)

1.2 m; 47 in. (PG II & III, SG 1.2 or solids)

0.8 m; 32 in. (PG III, SG 1.2 or solids)

X from-- 71 in. PG I: 1.2 (SG) x 1.5 m x 39.37 in./m

PG II: 1.2 SG x 1.0 m x 39.37 in./m

PG III: SG x 0.67 m x 26.38 in./m

Appendix B (Continued)**Section II. Equivalencies of Liquids**

	Specific Gravity ¹	Total (Each) Amount per Container		Gross Weight (pounds) (kilograms)	
water*	1.0	66.4	lb	198	89.8
PG I	1.2	79.2	lb	249	112.9
PG II	1.8	119.2	lb	290	131.5
PG III	2.7	179.2	lb	350	158.8

Note 1. Equivalent specific gravity derived from drop height as follows-- PG factor x density (or SG) = drop height, thus

SG = drop height/PG factor (49 CFR §178.603)

PG I: 1.5 m x SG = 1.8 m, thus SG = 1.2

PG II: 1.0 m x SG = 1.8 m, thus SG = 1.8

PG III: 0.67 m x SG = 1.8 m, thus SG = 2.7

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less.

Appendix C

Packaging Data Sheet


Section I. Exterior Shipping Container


Packaging Category: ___ single X combination ___ composite

UN Type: Steel open head drum (49 CFR §178.504)

UN Code: 1A2 Nominal (Rated) Capacity: 55 gal

UN Marking(s) on Packaging:

stenciled on drum side--  1A2/Y1.5/150/01
USA/M4599

embossed on drum bottom--  1A2 01 2 1.3-1.1-1.1

Specification Type and No(s): N/A

Overflow Capacity: N/A

Type/Materials: steel, open head drum, forged lug locking ring
1.3 mm cover (reported), 1.1 mm body (reported),
1.1 mm bottom (reported), round, sponge gasket

Manufacturer/Distributor: Meyers Container, Corporation
Huntington Park, CA 90255
CAGE 9Z473

Date(s) of Manufacture: 01 (embossed on drum bottom & side stencil)

Nomenclature: Drum, Steel, Shipping and Storage (label marking)

NSN: 8110-00-030-7780 (drum assembly)

Tare Weight (empty drum): 47 lb (includes cover, ring, and bolt)

Dimensions:

34-3/8 in. OD (drum height, including locking ring)
24-15/16 in. OD (drum body diameter, outside ring)

Closure (Method/Type): Forged lug locking ring
grade 2 bolt (307A)

Appendix C (Continued)

Section II. Inner Packaging/Article

Quantity of Inner Containers: 8 Capacity: 1 gallon each

Specification Type and No(s): N/A

Type: Round, clear, plastic, screw-cap bottle with handle;

Manufacturer/Distributor: Codes embossed on bottom not discernable

Material(s): Polyethylene HDPE, Recycling Code 2
White polypropylene (cap)

Date(s) of Manufacture: 9/95 (bottom marking)

Tare Weight (empty bottle): 0.25 lb; 113.4 g (Average)

Filled Weight: 9.97 lbs ea

Dimensions: 11¾ in. high; 6¾ in. diameter

Closure (Method/Type): Plastic screw cap, polyseal-24

Closure Specification Number(s): N/A Closure Manufacturer: N/A

Closure Dimensions: 1½" diameter (OD); ½" height (OD); 38/400 neck

Secondary Closure: Filament-reinforced tape (1 piece)

Secondary Closure Specification Number(s): NSN-- 7510-00-582-4772

- (1) A-A-1687B, Amendment 1 (marked) [canceled Jan 96]
- (2) PPP-T-97, type II (medium tensile),
class B (transparent) [canceled Jan 96]
- (3) ASTM D 5330-93, type II (medium tensile)

Secondary Closure Dimensions: 1 inch wide

Absorbent Manufacturer: HAZMAT PAC A-900, Houston, TX 77023

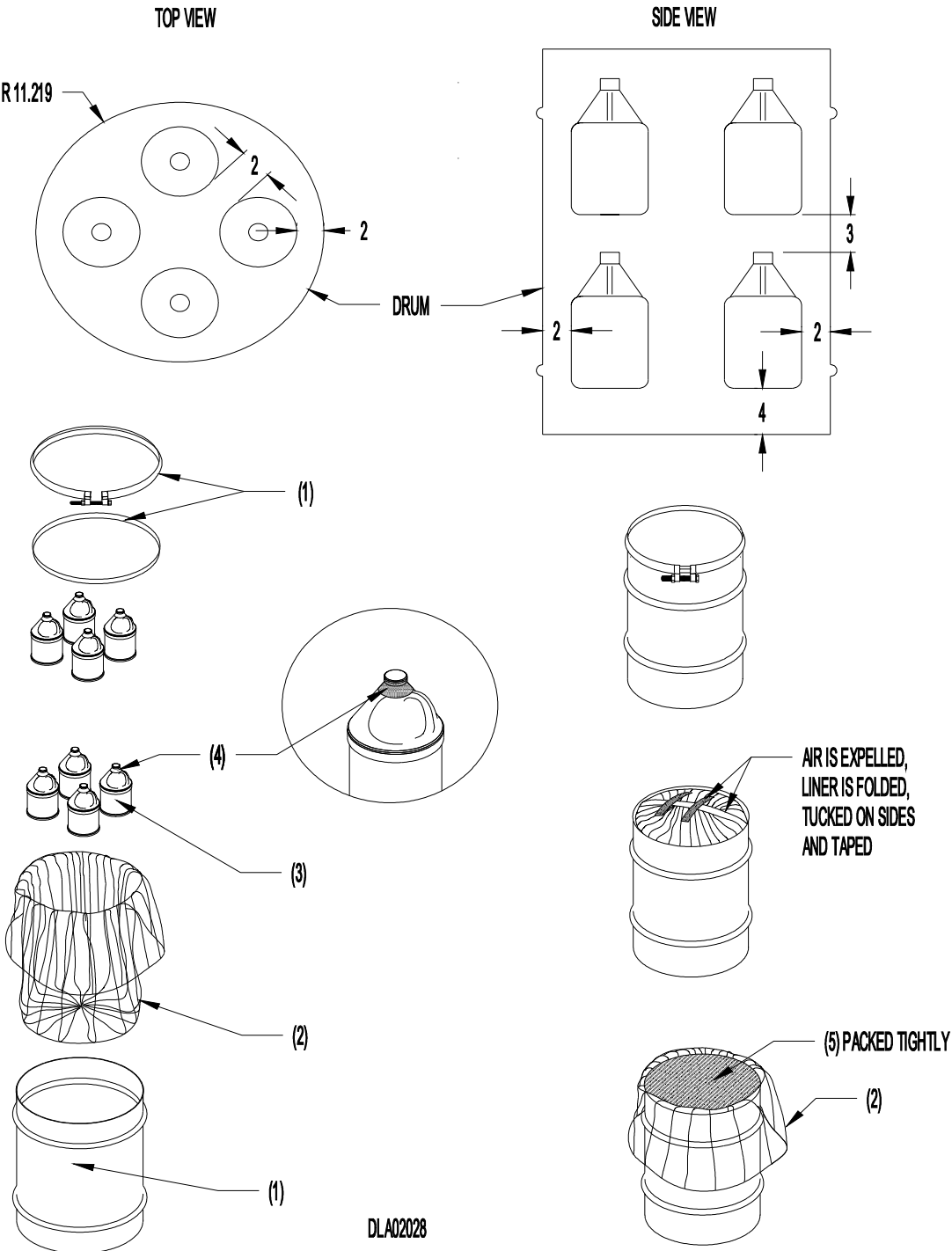
Appendix C (Continued)**Section III. Inner Packaging/Article** (continued)

Additional Description:

a. A 38" x 60", 4-Mil-poly bag was first placed in the steel drum for the purpose of encapsulating the absorbent and the test product. Approximately 4 inches of firmly packed, loose-fill absorbent cushioning was placed in the bottom of the drum. Four bottles were placed on the absorbent. More loose-fill absorbent was then firmly packed between, around, and over the bottles. Approximately 4 inches of firmly packed loose-fill absorbent covered the bottles. Four more bottles were placed on the layer of absorbent material. More loose-fill absorbent was then firmly packed between, around, and over the bottles. Approximately 2 inches of firmly packed, loose-fill absorbent separated the bottles from the sides of the drum, and approximately 2 inches of firmly packed, loose-fill absorbent was between the bottles. The four bottles were set behind and to the left of the other two bottles. The bottles in the top layer were placed so that the side of each bottle was perpendicular to the end of the adjacent bottle. The loose-fill absorbent must be firmly packed, especially toward the drum bottom chime. To pack the loose-fill absorbent, the use of a tamping stick is recommended.

b. For this configuration, either firmly packed, fine grade vermiculite or either of the following, firmly-packed cellulose fiber absorbent products, "HAZMATPAC® Absorbent A-900" or "Absorption Corporation Absorbent GP", can be used without any notable difference in performance.

Appendix D
Drawing



DLA02028

Appendix D (Continued)

ITEM	DESCRIPTION
1	55 GAL., 1A2 DRUM, STEEL, REMOVABLE HEAD, NSN: 8110-00-030-7780
2	PLASTIC LINER, 4-MIL POLYETHYLENE, 38 X 60 INCHES
3	1-GALLON, ROUND, PLASTIC, SCREW CAP BOTTLE, WITH HANDLE, QTY.8
4	1-INCH WIDE, PRESSURE-SENSITIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D 5330, TY II
5	CELLULOSE FIBER ABSORBENT, OR VERMICULITE, A-A-52450

Appendix D (Continued)



Appendix D (Continued)

